

REMARKS

Applicants respectfully request reconsideration. Claims 1-15 were previously pending in this application. Claims 1-15 are now amended. New claims 16-19 are added. Therefore, claims 1-19 are pending, with claims 1, 6, 7, 10, 11, 13, and 14 being independent.

I. Rejections Under 35 U.S.C. § 103

Claims 1-15 stand rejected under 35 U.S.C. § 103(a) as purportedly being unpatentable over U.S. Patent Application No. 2002/0015881 (Nakamura) in view of U.S. Patent No. 6,586,670 (Yoshikawa). Applicants request reconsideration in view of the claim amendments indicated above and the following remarks.

A. Nakamura

Nakamura describes a photoelectric conversion device and a method for making such a device (see title, ¶¶ [0050]-[0060]). Nakamura's photoelectric conversion device includes a particulate semiconductor layer (item 20 in FIG. 1), described at paragraphs [0043]-[0069]. Various processes used to form the particulate semiconductor layer are individually identified at paragraphs [0050]-[0060].

In describing the prior art, Nakamura makes clear that it is undesirable to use temperatures exceeding 400 °C to form the particular semiconductor layer (see ¶ [0004]). Therefore, Nakamura's processes avoid temperatures about 400 °C. He states:

“The present invention is characterized in that the above-mentioned state that has been to be resulted from ‘firing’ is reached *not by high-temperature heating* but by a method including one or more of the following steps” (¶ [0049], emphasis added).

Nakamura then lists several steps, with the highest temperature used being less than 350 °C (¶ [0050], [0062]). In fact, Nakamura describes that for use with a polymer substrate, the upper temperature limit is preferably 300 °C (¶ [0062]).

In describing the processes used to form the particulate semiconductor layer, Nakamura mentions that heat can be applied to remove unnecessary matter from the surface (§ [0062]). However, he does not describe this process in detail, and does not list any specific amounts of unnecessary material removed or remaining. In addition, he only briefly mentions that irradiation is an effective means for removing unnecessary matter from some particles, without providing any details about this process (§ [0062]).

B. Yoshikawa

As with Nakamura, Yoshikawa describes a photoelectric conversion device and methods for making the device (see Title). Similar to Nakamura, the photoelectric conversion device of Yoshikawa includes a semiconductor fine particle layer, which is described at col. 19, line 4-col. 20, line 54. The semiconductor fine particle layer can be heat-treated at low temperatures, and the heat-treatment can be performed while also applying an infrared ray, an ultraviolet ray, an electric field, an ultrasonic wave, or a microwave (col. 20, ll. 28-31). He states:

“To remove unnecessary organic compounds, etc., the heat treatment is preferably carried out in combination with evacuation, oxygen plasma treatment, washing by pure water, a solvent or a gas, etc.” (col. 20, ll. 31-35).

Thus, Yoshikawa does not teach that an ultraviolet ray is used to remove compounds, but rather that heating in combination with evacuation, oxygen plasma treatment, washing by pure water, a solvent, or a gas is used to remove unnecessary compounds.

C. Claim 1 is Non-obvious Over Nakamura in View of Yoshikawa

Claim 1 is not obvious over Nakamura in view of Yoshikawa because Nakamura teaches away from any modification which would meet the limitations of the claim. For example, claim 1 recites, in part:

A method of manufacturing a photoelectric conversion device, comprising:
coating a transparent conductive substrate with a paste comprising a semiconductor fine grain and a binder made of a polymer compound;
sintering the paste at a temperature of between approximately 400 °C to 500 °C to form a semiconductor layer made of the semiconductor fine grain... (emphasis added).

Nakamura teaches away from any modification of his process that would result in sintering at the recited temperatures.

As described above in section I(A), Nakamura teaches that heating at temperatures exceeding 400 °C is undesirable, and makes clear that his invention avoids such temperatures. In fact, his invention has an upper temperature limit of 350 °C (see ¶ [0050]). Thus, Nakamura teaches away from using temperatures in the range recited in claim 1. One of skill in the art applying the teachings of Nakamura would therefore use temperatures lower than 350 °C.

For at least this reason, the rejection of claim 1 cannot stand, and Applicants request that it be withdrawn. Claims 2-5, and 16-18 depend from claim 1 and are patentable over the art of record for at least the same reasons. Therefore, Applicants request that the rejections of claims 2-5 be withdrawn.

Support for the amendments to claim 1 can be found at least at page 26, lines 19-23 of Applicants' disclosure.

D. Claim 6 is Patentable Over Nakamura in View of Yoshikawa

Claim 6 is non-obvious in view of the proposed modification of Nakamura because the proposed modification would not have met all of the limitations of the claim. The Office Action contends that one of skill in the art would have used the heating of Nakamura to remove organic substances. Even if this were true (which Applicants do not concede is the case), claim 6 recites:

A photoelectric conversion device comprising:
a semiconductor layer made of semiconductor fine grain,
wherein the semiconductor fine grain is fused by sintering,
and *wherein the semiconductor fine grain comprises a plurality*

of types of semiconductor fine grain exhibiting photocatalyst behavior (emphasis added).

Thus, even had one of skill used Nakamura as proposed in the Office Action, at least the above-highlighted limitation of claim 1 would not have been met.

Nakamura does not describe a semiconductor layer made of a semiconductor fine grain that comprises a plurality of types of semiconductor fine grain exhibiting photocatalyst behavior. Rather, Nakamura simply mentions that some particles have a photocatalyst function. But that alone does not meet the above-highlighted limitation of claim 6, since there is no discussion in Nakamura of using a plurality of types of semiconductor fine grain that exhibit photocatalyst behavior. Yoshikawa does not remedy this deficiency of Nakamura. Therefore, the proposed modification of Nakamura would not have met the limitations of claim 6.

For at least this reason, Applicants request that the rejection of claim 6 be withdrawn.

E. Claim 7 is Non-obvious Over Nakamura in View of Yoshikawa

Claim 7 is non-obvious over Nakamura in view of Yoshikawa because the proposed modification of Nakamura would not have met all of the limitations of the claim, which recites:

An apparatus comprising:
a semiconductor layer made of semiconductor fine grain
and comprising less than approximately 1.4 atomic % of organic
substances.

Contrary to the assertion in the Office Action, it would not have been obvious to one of skill in the art to use routine experimentation to adjust the heat/UV treatment of Nakamura to obtain the claimed invention. Rather, Nakamura and Yoshikawa give no guidance as to how the claimed invention could have been achieved.

As described in section I(A) above, Nakamura does nothing more than mention that irradiation is an effective means to remove unnecessary matter. He gives no details about the process and does not describe how it can be used to achieve any particular levels of removal. Yoshikawa does not add anything in the respect. In fact, Yoshikawa does not even describe using

UV treatment to remove unnecessary matter. Rather, as set forth in section I(B) above, Yoshikawa explains that heating in combination with evacuation, oxygen plasma treatment, washing by pure water, a solvent or a gas are used to remove unnecessary organic compounds. He does not describe using UV irradiation to remove unnecessary matter. Thus, Nakamura and Yoshikawa do not teach all of the limitations of claim 7, and give no guidance as to how to achieve the claimed semiconductor layer.

For at least this reason, the rejection of claim 7 cannot stand, and Applicants request that it be withdrawn. Claims 8, 9, 12, 15, and 19 depend from claim 7 and are allowable for at least the same reasons. Therefore, Applicants request that the rejections of claims 8, 9, 12, and 15 be withdrawn.

F. Claim 10 is Non-obvious Over Nakamura in View of Yoshikawa

Claim 10 is non-obvious over the proposed modification of Nakamura because the proposed modification would have failed to meet all of the limitations of the claim. For example, claim 10 is directed to a method comprising "irradiating the semiconductor layer with ultraviolet rays for approximately 70 hours." Modifying Nakamura as proposed in the Office Action would have failed to meet at least this limitation.

As described in Section I(A) above, Nakamura does nothing more than mention that UV irradiation can be used to remove unnecessary matter. He provides no details as to how the UV irradiation should be applied. Similarly, as discussed in section I(B) above, Yoshikawa provides absolutely no details as to how the ultraviolet ray he mentions should be applied. Thus, one of skill in the art applying the UV treatment process of Nakamura to a semiconductor layer would not have done so in the manner required by claim 10. For at least this reason, claim 10 is non-obvious in view of Nakamura and Yoshikawa. Accordingly, Applicants request that the rejection of claim 10 be withdrawn.

G. Claim 11 is Non-obvious Over Nakamura in View of Yoshikawa

Claim 11 is non-obvious over Nakamura for reasons similar to those set forth in Section 1(E) above. For example, claim 11 requires “wherein the carbon component is less than one atomic % of the semiconductor layer.” Nakamura and Yoshikawa fail to teach or suggest this limitation, such that the proposed modification of Nakamura would not have met all of the limitations of the claim.

Nakamura and Yoshikawa are entirely silent as to any amounts of carbon present in the semiconductor fine particle layers they describe, and provide no detail as to the processing steps which could be applied to achieve such low levels of carbon. Thus, one of skill strictly applying the teachings of Nakamura and Yoshikawa would not have arrived at the claimed invention. For at least this reason, claim 11 is non-obvious in view of Nakamura and Yoshikawa, such that Applicants request the rejection of claim 11 be withdrawn.

H. Claim 13 is Non-obvious Over Nakamura in View of Yoshikawa

Claim 13 is not obvious over Nakamura in view of Yoshikawa because Nakamura teaches away from any modification of his process that would use temperatures in the range recited in claim 13. For example, claim 13 requires “sintering the paste between approximately 400 °C and 500 °C...” As described above in section I(C), Nakamura clearly teaches away from using such temperatures. Thus, one of skill would not have modified Nakamura to achieve the claimed invention.

For at least this reason, Applicants request that the rejection of claim 13 be withdrawn.

I. Claim 14 is Non-obvious Over Nakamura in View of Yoshikawa

Claim 14 is non-obvious over Nakamura in view of Yoshikawa for at least the same reasons as those described in section I(D) above with respect to claim 6. Claim 14 requires a semiconductor layer made of semiconductor fine grain and comprising a plurality of kinds of semiconductor fine grain exhibiting photocatalyst behavior.

As discussed, Nakamura does not describe a semiconductor layer made of a semiconductor fine grain that comprises a plurality of types of semiconductor fine grain exhibiting photocatalyst behavior. Rather, Nakamura simply mentions that some particles have a photocatalyst function.

Yoshikawa does not remedy this deficiency of Nakamura. Therefore, the proposed modification of Nakamura would not have met the limitations of claim 14.

For at least this reason, Applicants request that the rejection of claim 14 be withdrawn.

II. New Claims

New claims 16-19 have been added to further define Applicants' contribution to the art. Each of the claims is a dependent claim and is therefore allowable over the art of record for at least the same reasons as is the claim from which it depends.

CONCLUSION

A Notice of Allowance is respectfully requested. The Examiner is requested to call the undersigned at the telephone number listed below if this communication does not place the case in condition for allowance.

If this response is not considered timely filed and if a request for an extension of time is otherwise absent, Applicant hereby requests any necessary extension of time. If there is a fee occasioned by this response, including an extension fee, the Director is hereby authorized to charge any deficiency or credit any overpayment in the fees filed, asserted to be filed or which should have been filed herewith to our Deposit Account No. 23/2825, under Docket No. S1459.70081US00.

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